

Dispersion Curves of the Dielectric Tube

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In order to study the dielectric accelerators, we have calculated the dispersion curves of these structures.

The inner radius a of dielectric, whose permittivity is ϵ , is determined by the bunch size. By using the analytic results^[1, 2], we program codes with Mathcad 7.0 to determine the outer radius b and the dispersion curve of TM_{01} mode.

With the same a , b and ϵ , we calculate the dispersion curve of HEM_{11} mode by Mathcad 7.0.

The dispersion results, data and plots, are handled by SigmaPlot 4.0. The results, which are shown in Figure 1 and 2, are for $a=0.003m$, $b=0.00456m$ and $\epsilon=20$.

Conclusion

As shown in Figure 1, one of the interesting characteristics of dielectric accelerating structure is that the frequency of the HEM_{11} mode (first deflection mode) is lower than that of the acceleration mode. Because the deflection force is a function of $\sin(kz)$, this implies very different and improved conditions for the single bunch BBU problem compared to conventional structures where the HEM_{11} is always higher in frequency than accelerating TM_{01} mode.

Further calculating should be conducted, with particular attention to the sensitivity of dispersion curves to a , b and ϵ . The dispersion curves of some higher order modes, e.g. TM_{02} and HEM_{12} , also should be conducted

Reference

- [1] King-Yuen Ng, Wake fields in a dielectric-lined waveguide, Physical Review D, Vol. 42, No. 5, 1819(1990).

[2] M. Rosing and W. Gai, Longitudinal- and transverse-wake-field effects in dielectric structure, Physical Review D, Vol. 42, No. 5, 1829(1990).

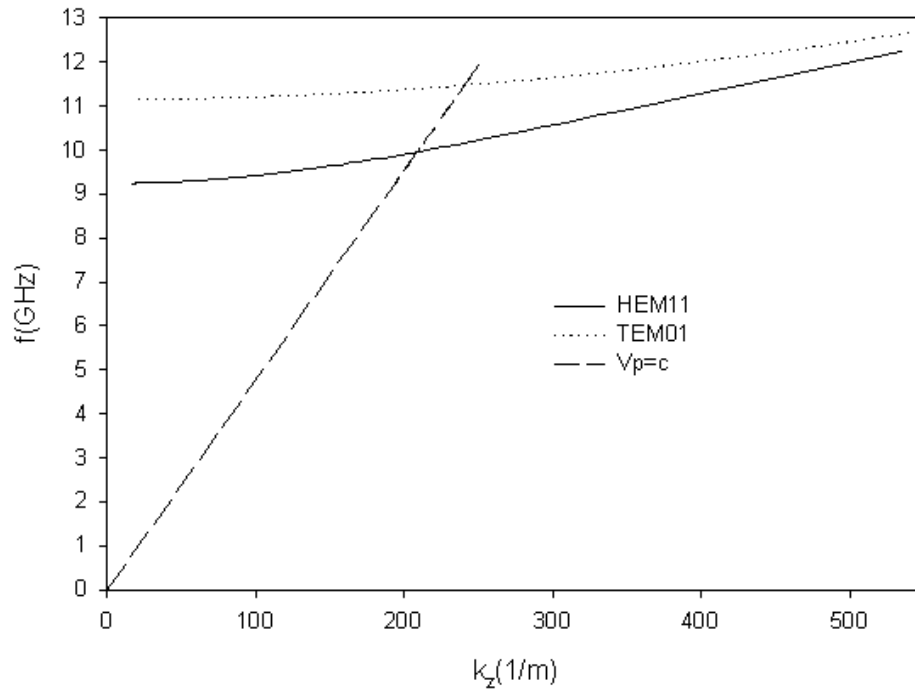


Figure 1. Dispersion Curves of Dielectric Tube

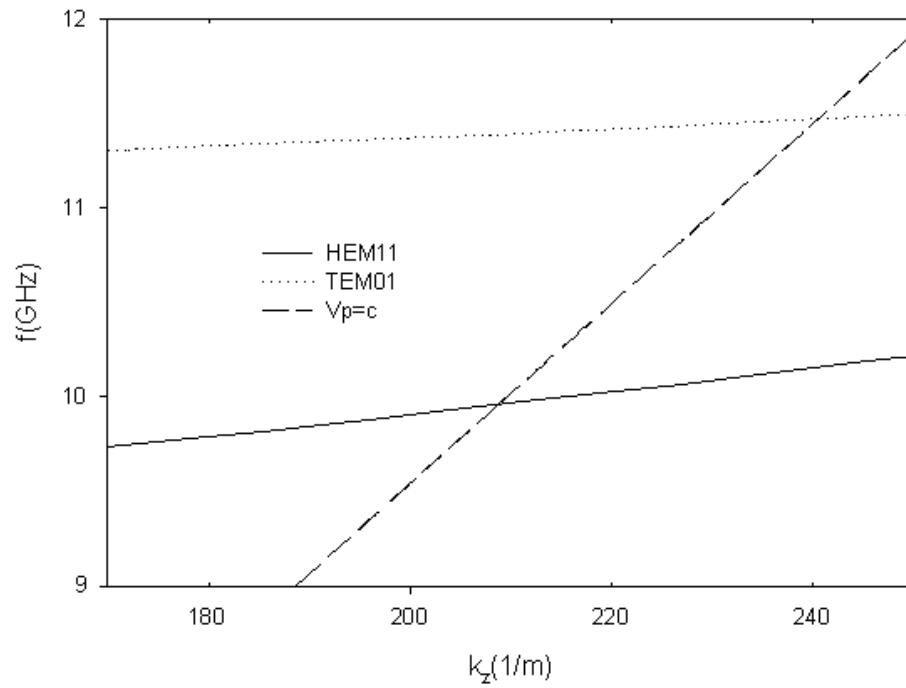


Figure 2. Dispersion Curves of Dielectric Tube in the area interesting